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A numerical study of viscous dissipation effect on non-Newtonian fluid flow inside elliptical duct

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Abstract: Laminar heat transfer inside duct with elliptical cross section, subjected to uniform wall temperature is studied by taking into account the viscous dissipation. The temperatures distributions are evaluated numerically by using a dynamic Alternating Direction Implicit method (dADI). Nusselt number (Nu) is presented graphically for various Brinkman number (Br) and aspect ratio for a non-Newtonian fluid described by the power law model. The results obtained showed a good agreement with those found in the literature for fluid flow in circular cross section ducts and in elliptical cross section without viscous dissipation effects. It is shown that in the fully developed region and for Br ? 0, Nusselt number has a fixed asymptotic value independent of Brinkman number (Br). In the thermally developing region, it is observed a single fixed point independent of heating or cooling condition which the numerical value is equal to the asymptotic Nusselt number. Another relevant feature is that in the fully developed region, the Nusselt number increases with the aspect ratio.

Keywords : Elliptical duct section, Viscous dissipation, Non-Newtonian fluids, Power law model, Laminar forced convection